

THE WALTER REED ARMY INSTITUTE OF RESEARCH

Behavioral Biology

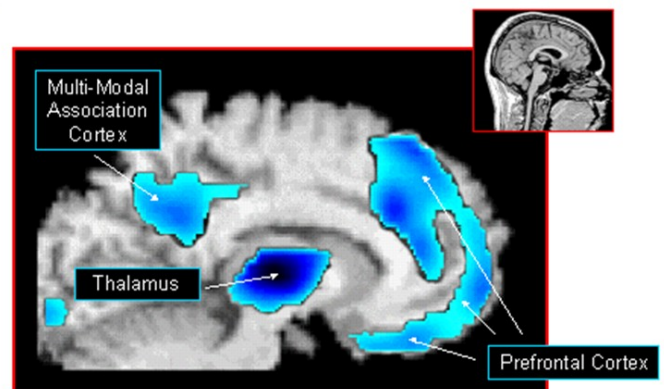
Investigators in this program are concerned with the challenge of maintaining warfighter alertness and decision-making ability in the face of limited and fragmented sleep and recovery time during combat and sustained training operations. Using information from the field, the program's specially designed human sleep research labs, brain imaging studies, and a variety of mathematical modeling and simulation tools, scientists are gaining deeper understanding of relationships among cognitive performance, the amount and timing of sleep, the ability to "bank" sleep against future demand, the action and effects of stimulant and sleep-inducing drugs, and the role of sleep in post-traumatic stress disorder (PTSD) and recovery from head injury.

Mission

- To investigate and develop the means to optimize war-fighter readiness, efficacy, and resilience during continuous military operations when there is little or no opportunity to sleep.
- To identify the role of sleep in facilitating resilience to, and recovery from, exposure to a variety of combat-related stressors.

Research Priorities:

- Interventions to enhance the recuperative efficiency of sleep, and enhance Service Member resilience to the deleterious physical and psychological effects of sleep loss.
- Sleep-related strategies to enhance resilience to, and recovery from, mTBI events



Physiological and Behavioral Effects of Sleep Loss

Our expertise is in:

- Alertness and performance management, including development and validation of (a) hardware and software to predict cognitive readiness in Service Members, (b) pharmacological interventions to restore and sustain readiness and mitigate PTSD, (c) neurocognitive assessment testing; and (d) animal models of PTSD.
- Neuroimaging studies to determine the biological basis of sleep-related performance deficits and the physiological basis of individual differences in resilience to sleep loss and other stressors.

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The scope of research challenges:

- Soldier fatigue is manifested as slowed reaction time, diminished problem-solving ability, reduced situational awareness, impaired judgment, and is an inescapable fact of current military operations.
- The primary causes of Soldier fatigue are inadequate sleep and circadian rhythm misalignment. In addition to the short-term effects of acute sleep loss on performance and military effectiveness, recent findings suggest long-term effects of chronic sleep restriction on physical and psychological health and resilience
- A comprehensive fatigue management system (FMS) is required. This FMS must include: (a) the means to monitor Soldier sleep, alertness, and performance; (b) a mathematical model to accurately predict individual Soldier performance into the future; and (c) effective interventions (pharmacological and non-pharmacological) to facilitate sleep and alertness as needed.

Major Accomplishments

- Performed a series of studies demonstrating effectiveness of “sleep banking” as a prophylactic countermeasure against the effects of subsequent sleep restriction
- Multiple patents related to the mathematical sleep/performance prediction model have been filed. Several of these have been licensed by industry, and form the basis of commercially-available products.
- Wrist actigraphy, a technology invented and developed by our personnel, has over the past two decades become a widely- used and accepted commercially-available tool that is currently used in a variety of clinical and research settings.
- Developed and validated caffeinated chewing gum, Stay Alert, as a fatigue countermeasure, leading to its fielding as a component of First Strike rations.

Our future directions include:

- Conducting experimental studies to determine whether the recuperative value of sleep can be increased via ‘slow wave sleep enhancement.’
- Determining the role of sleep in facilitating resilience to both physical (e.g. mTBI events) and psychological stressors.
- Determining the extent to which protein synthesis is facilitated by sleep (an issue with broad implications- e.g. including the role of sleep in recovery from mTBI events).

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